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SEARCH, TRANSFER AND DISSEMINATION OF TECHNOLOGICAL INFORMATION in the Visual Communication Product Department of the General Electric Co.

by

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This report was prepared under the direct supervision of Professors Eric W. Lawson, Peter G. Franck and E. Bruce Fredrikson in August-September 1968.

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RESEARCH REPORT ON SEARCH AND DISSEMINATION

The following report is a summary of the findings from research undertaken by Robert H. Hamilton, under the direction of Dr.'s: P. G. Franck, E. W. Lawson, and E. B. Fredrikson. This research is a part of a NASA contracted study to the Syracuse University Business Research Bureau.

Purpose

The purpose of this research is to examine in depth the transfer and dissemination of technological information from sources outside the commercial firm and to find out how it is utilized in the development of commercial products. Many companies of varying size, specialization and orientation are expected to participate in the investigations. It is anticipated that a broad sample base of companies should yield answers concerning how government agencies, like NASA, can design a data bank and dissemination system to best accommodate the needs of companies who can use this information. A better system for dissemination of information will help increase the potential development of commercial products resulting from government research.

Major Areas of Emphasis for this Research

The heart of the research will focus on four basic areas:

1) The types of media most frequently used to acquire technical information from sources outside the company such as: professional journals, trade publications, trade shows, personal contact, formal library dissemination facilities, government publications, supplier catalogs, the consumer, etc.

2) The motivational stimuli for those who receive or search for technological data to pass it on to a colleague or store it for future reference.

3) The manner in which the technological information gets absorbed into the commercialization or new development process.

4) Lastly, a rough estimate of the cost of search and dissemination of technological information to the company.

Assumptions

For definitional purposes it will be necessary to make some assumptions about what is meant by the terms "company," "technological information," and "innovation."

It will be assumed that "company" will refer to any autonomous, independent profit and loss center. Consequently, divisions of a company or product departments will be considered separate "companies" if their operations have the above characteristics.

The term "technological information" will include not only information which answers a specific technological problem or reveals the state-of-the-art within an industry, but also information from the market which influences the direction technology will take in the company.

"Innovation" will cover both major theoretical breakthroughs and also efficiency and reliability improvements in products, components or systems. It will not include, however, those minor product differentiation changes which characterize planned obsolescence, i.e., exterior design, styling, color, etc.

Because of the impracticality of interviewing all the managerial staff within each product department, interviews were restricted to a sampling of section and subsection managers in three main functional groups: marketing, engineering, and manufacturing. Technical assistants and other non-managerial personnel were not included in the research simply because most of the search and dissemination efforts are undertaken by managers.

Each interviewee was cautioned to answer questions in a way which would reflect the activity of not only himself, but his men also. In cases where the activity and opinions of a

manager were significantly different from what could be expected from his men -- the differences were noted.

Methodology

It was mentioned earlier that evaluation of how government data banks and mechanized dissemination systems can serve the commercial firm must be based on in-depth analysis, since little is known about what kinds of companies, what size or what industries can best benefit from such a service. Depth interviews were agreed upon as the best means of initial evaluation of at least a small sampling of diverse kinds of companies. After analyzing these results, perhaps an effective questionnaire could be constructed which would allow a large sampling at economical costs.

For this study, selected interviews were undertaken in two General Electric Product Departments in Syracuse, New York: Visual Communications and Semi-Conductor.

The Host Product Departments

Both Visual Communications and Semi-Conductor Product Departments are organized in the same fashion as all other G.E. product departments - decentralized, autonomous units, that pay for their own development work, and essentially operate as separate companies within G.E.

Throughout the product department organizations at G.E. one will find a fair degree of marketing orientation. This emphasis undoubtedly comes about since the performance of each product department is evaluated on the basis of profits and how well it meets its own objectives.

VISUAL COMMUNICATIONS - CHARACTERISTICS AND BACKGROUND

The Visual Communications Product Department produces broadcast cameras and peripheral equipment including antennas, transmitters, switching equipment, video tape and film. A small business section has been spun off as a separate operating unit which produces closed circuit television systems.

Interestingly, there is a tremendous difference in the markets for these two products. Broadcast equipment serves a market characterized by approximately 900 rather well defined customers -- most of which are neatly pin-pointed by the FCC. In contrast, the closed circuit market is one of tremendous size and unknown potential. The broadcast market appears to be extremely price inelastic. Users will pay high prices for improvements in product performance and reliability. Closed circuit users on the other hand, are fairly price elastic and look for product applications as much or more than technical breakthroughs. The contrast within the Visual Communications Product Department made it a good candidate for the study.

For simplicity, the major characteristics of both the Closed Circuit Business Section and the Broadcast Business Section are presented below:

1. Number of Managerial and Professional Personnel Who Undertake Some Search and Dissemination of Tech Information (not including technicians, tech assistants, foremen, or supervisors)

	Broadcast	Closed Circuit
Marketing	80	8
Engineering	47	12
Manufacturing	45	6

2. Level of Sales

0-4 million 5-20 million 21-40 million 41-100 million 100+ million

very small small medium large very large

(Relative sizes of business sections as broken down by G.E. financial managers.)

Broadcast	Closed Circuit
medium	very small

3. Type of Products

Broadcast	Closed Circuit
black and white, color, TV cameras antenna systems cables transmitters switching equipment audio equipment and peripheral audio and video equipment	closed circuit systems including: black and white camera monitors cables video tape recorders and replay equipment

4. Current Focus of Development

Broadcast	Closed Circuit
Development of automated broadcast equipment using telemetry	Development of smaller and more portable cameras, especially for color broadcast.

5. Development Over Three Years

Broadcast	Closed Circuit
- 8 major lines - 70% new in past 3 yrs.	- 6 major lines - 40% new in past 3 yrs.

6. Average Market Life of Products

Broadcast	Closed Circuit
3-5 years	5 years

7. Commercialization Turn-around Time

Broadcast	Closed Circuit
2 years	1-1/2 years

8. Market Characteristics

Broadcast	Closed Circuit
- fairly price inelastic	- price for some lines is very elastic
- narrow market	- diverse, wide market
- emphasis on tech advancement	- emphasis in most lines is on new applications for existing technology
- market is mature and saturated	- market is quite young and unsaturated

9. Major Competitors

Broadcast	Closed Circuit
RCA	Motorola
Phillips	RCA
	approximately 18 others

Visual Communications Interviewees

The following are the titles of the gentlemen who participated in the interviews at Visual Communications. The names and addresses appear in the Appendix.

Broadcast Business Section

Manager of Engineering
Manager of Audio/Video Development
Manager of Audio/Video Design Engineering
Manager of Shop Operations
Manager of Broadcast Sales
Manager of Customer Service
Manager of Product Planning
Manager of Market Research
Manager of Finance

Closed Circuit Business Section

Manager of Marketing
Manager of Engineering

In addition:

Director of Library Services for Electronic Park in Syracuse

By function the breakdown is as follows:

VISUAL COMMUNICATIONS		
	Broadcast	Closed Circuit
Engineering	3	1
Manufacturing	1	
Marketing	4	1
Finance	1	
	Other	
Library Services		1

RESULTS - VISUAL COMMUNICATIONS

The next section will include the results of the interviews. Interview summaries may be found in the Appendix, should you wish to refer to any particular individual. While reading through the results it will be useful to keep in mind the background information previously mentioned.

Interview data will be broken down into the following sections:

1. media
2. motivation
3. commercialization
4. costs

At the end of each section there will be a list of implications which apply to the General Electric Company and in addition, hypotheses which relate to the NASA study. These hypotheses will be either verified or contradicted upon the completion of additional research in other companies. Therefore, do not make the mistake of treating the hypotheses developed from this study as conclusions for the entire NASA research project.

Kindly, keep in mind that the interview summaries are in the Appendix and have been put there so they would not break up the presentation of the results. However, for thorough understanding -- the summaries should be read first.

1. Media

The respondents were asked to rank the media sources they most frequently used to acquire technological data for the purpose of either problem solving or state-of-the-art surveys. It was realized that certain media are more applicable than others for specific and general information needs. However, these media differences were automatically reflected in the rankings of the three functional groups, since their information needs were different.

Media selections were made from the following list:

TIS (technical information series - G.E.)
trade journals
professional journals
R & D Lab reports
Electronic Lab reports
trade shows
customer contact
in-house conferences (GOSAM, TAM-TAC)
personal contacts (excluding customers)
patent and licensing information
consultants
other product departments at G.E.
government reports
G.E. Library
Department Library
supplier and vendor catalogs
dealer information
foreign liaison offices
corporate analyses (non G.E.)

Several of the media sources are unique to the General Electric Company and will require some additional explanation.

The TIS Report is a G.E. technical information series which originates out of Schenectady. The series is produced from reports submitted by personnel in any one of the

160 G.E. product departments. The subject matter contained in the TIS can range from the most technical to public relations. The criteria for having an article accepted in the TIS is not rigid. As one engineer aptly put it: "If you have found the time to think of something good enough to express on paper, and you have found time to write your ideas in report form, while at the same time you have received permission to release the information -- you can be assured of getting it into the TIS." Published monthly and well indexed, the TIS is the written data bank for the General Electric Company.

Two of the General Electric research facilities produce printed reports of their work. Both the R & D Lab Report and the Electronics Lab Report contain highly technical research data on technology development currently being undertaken by the Labs -- either independently or under contract with a specific Product Department. Publication of both of these media is more randomized than the TIS.

The General Electric library staff makes available to all product departments indexed summarized reviews of the TIS, R & D Lab Report and the Electronics Lab Report.

In-house conferences are not especially common at General Electric -- at least for the product groups this researcher examined. The GOSAM conference is held once or twice a year and focuses on new applications for semi-conductors. The Semi-Conductor,

Appliance, Computer and Defense Product Departments were the founders of this conference.

TAM-TAC sessions are also held once or twice a year, typically among the top management of the defense oriented product departments. The objective is simply to find out what each product department is doing so that no efforts will be duplicated. The kinds of product departments included in TAM-TAC sessions are gradually being expanded into areas other than defense.

Depending upon the necessity for a product department to retain and store texts, trade and professional publications, etc., they will often develop their own specialized libraries -- separate from the main G.E. Library. Such is the case with the Semi-Conductor Product Department, for example.

Foreign liaison offices represent the overseas arm of the Technical Information Service in Schenectady. They will gather important technology from overseas sources and disseminate it to the domestic G.E. Tech Service Center. There it will be summarized and indexed for future reference by any G.E. product department. Publication by the foreign offices is at random.

Corporate analyses previously noted on the media list refer to any corporate report originating outside the GE company; for example, the Bell Telephone Lab Report.

Media usage for the purpose of acquiring technical information did not vary much between the Broadcast Business Section and Closed Circuit Business Section. In practically all instances, personal contact was ranked as a very good, efficient source of technological information -- for either problem solving or state-of-the-art survey.

Certain media did appear consistently high in the rankings of certain functional groups.

- customer contact was consistently ranked by marketing as the number one source of information used to guide technological development.

- personal contact with in-house engineering was consistently ranked by manufacturing as the number one source of technical information.

- personal contact with the researches in the R & D Lab,
  R & D Reports,
  and trade and professional journals, were all consistently ranked by engineering as one of the top three sources of technical information.

In every instance, government reports were ranked very low by all functional groups.

A summarized ranking of the first seven media sources appears below.[1]

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[1]Calculated by weighting each media according to its ranking as mentioned in the interviews.

SUMMARIZED MEDIA RANKINGS

Broadcast Business Section

	Marketing	Engineering	Manufacturing
1.	customer contact	R & D Lab	personal contact (in-house)
2.	personal contact	TIS	trade and professional journals
3.	trade show	professional and trade journals	R & D Lab
4.	professional and trade journals	personal contact, GE Library, professional conf.	professional conferences, trade shows
5.	professional conferences	corporate analyses	vendor information
6.	vendor-dealer info., TIS, GE Library	customer contact, govt. reports	TIS, GE Library
7.	government reports	license and patents information	government reports
focus of technical info. needs	trends, state-of-the-art, competitive, development	problem solving, performance, and development state-of-the-art	state-of-the-art process and methods info.

Closed Circuit Business Section

	Marketing	Engineering
1.	customer contact	trade and professional journals
2.	trade show	personal contact
3.	personal contact (in-house)	professional conferences
4.	dealer-vendor info.	vendor information
5.	trade and professional journals	trade show
6.	trade and professional conferences	R & D Lab, TIS
7.	government reports	government reports
focus of technical info. needs	trends, state-of-the-art, applications, development, competitive	problem solving applications, performance, development state-of-the-art

Besides obvious consistency among the marketing men about their reliance on customer contact, the trade show was considered a major source of state-of-the-art information by both business sections. Acknowledging the fact that the Broadcast Business Section spends upwards of $300,000 on the big industry show each year, it would seem appropriate that this occasion should turn out to be a valuable source of direction for technology.

Certain differences in media usage between the Broadcast and Closed Circuit Business Sections were due mainly to market differences. The marketing sources cited by Closed Circuit are slightly more competitively oriented. The emphasis seems to be more on feedback, than on simply data gathering.

The engineering people for the broadcast section seem to be oriented more toward new technology acquisition. This is brought out in the interviews and in the media rankings where personal contact with the researchers in the R & D Center is highly valued.

When asked how the R & D people received their information, the respondents answered by describing the informal group structure that apparently exists among the top research scientists around the world. One respondent described the interaction.

The research scientists who are really at the top of their field have close affiliations with other experts in the same discipline around the world. Their sphere of influence,

pride, motivation, competition, prestige, etc., falls with this informal, personal group of colleagues. The colleagues, of course, are not necessarily members of the same company, or citizens of the same country. When something important is discovered by any prominent researcher, he will most likely initially communicate that information to a colleague for verification, approval, etc. In this manner the specialized fraternity of researchers disseminates information within its group long before it is in any kind of published form -- in-house or out. Consequently, when an engineer is up against a problem in theory about which he has difficulty finding information, a logical source for him to explore would be one of the specialists in the R & D Center. The research specialists can usually direct the engineer to appropriate source materials or to a researcher who will be able to help.

Engineering in the Closed-Circuit Business Section seems to focus more on application information than on technological theory. Although both forms of information are dealt with. The media rankings for Closed-Circuit reflect an emphasis on applications by ranking trade and professional journals, vendor-dealer information, and personal contact higher than R & D Lab, TIS, etc.

Manufacturing personnel for both the Broadcast Section and the Closed-Circuit Section seem to get most of their direction from engineering inputs. State-of-the-art information is routinely acquired through the trade and professional journals.

Use of government information is mostly for process, reliability, and quality control data.

Government reports were seldom used by any functional group. This researcher got the distinct impression that the highest use of government reports were in the defense oriented product departments. People in Visual Communications were hesitant to use government data for some of the following reasons:

1) Most engineers feel that there is little fallout from NASA and DOD research that can be applied to the broadcast business as it exists under the current commercial conditions.

As one engineer explained, Visual Communications has known for several years how to design a more efficient television system than is currently in existence (see interview with Mr. Bias, Engineering Manager, VCC). Redesign, however, means the use of very expensive components, means realignment of the entire television system from camera to transmitter to antenna to receiver. Since there are 90 million television receivers currently working on the old system -- it becomes practically impossible to commercially incorporate a radical new design. A further constraint is that of the FCC specifications by which the industry produces its products. In order to change those specifications to accommodate a radical new design, it would mean not only getting the government to agree, but getting all of the competitors to agree

too. This, as one can imagine, would take a great deal of time and cooperation.

All this is to say that large sophisticated fall-out from NASA or DOD systems is not practical at the present time because of the commercial constraints in the broadcast business. Certainly, however, materials improvements, circuit design, and automation advances represent the kinds of progress which can be greatly accelerated through proper dissemination from government sources.

Currently, the technical people at Visual Communications have great hope that NASA or DOD information will be of some help in developing telemetry controls for television cameras -- similar to the telemetry used in missile control.

The next question to examine is the department's awareness of government dissemination systems that could conceivably assist VC in getting information about subjects such as telemetry. There are some interesting ramifications of this question.

The respondents in Visual Communications were asked if they knew of the existence of a government computerized dissemination system that was directly linked to ten of G.E.'s fifty-five company libraries, including the library in Syracuse at Electronics Park. The dissemination system, as described by Mr. Thomas Spencer, Director of Library Services in Syracuse, is a link-up to the Department of Defense data bank in Washington, D.C.

According to Mr. Spencer, any engineer in the company from any domestic location can request a data search on a particular topic. The procedure entails initiation on the part of the engineer. He can do one of two things: call the G.E. Library staff and explain the details of what kind of search he wants so that they can call Washington, or call a librarian at the DOD directly.

If the request is put in specific enough language, a data dump will be undertaken in the DOD extracting the numbers of the reports focusing on the subject area requested. These numbers are then transmitted by computer-link directly to the G.E. Library which made the request. Each of the ten G.E. Libraries on line with DOD have on storage a duplicate DOD data bank in microfische form. Using the numbers sent in by DOD, the G.E. Library staff can pull out the appropriate reports, duplicate them on microfische or hardcopy for the engineer initiating the search. All this transpires over a period of about ten days. However, this fall a fast system will be introduced to cut the reporting time to one day.

DOD reports cover practically all areas of technology and assumingly, because of their usefulness, the General Electric Company subscribed to the service. The following results from the interviews reveal some interesting replies. In every case except one, none of the gentlemen had ever heard of the DOD link-up. In other words:

1 out of 10 men knew about the DOD link-up.

It is acknowledged that some of the men might be unconsciously using the system when they request government reports. Also, since the use of government data is so low in Visual Communications, there would be little motivation to inquire about the DOD link. However, it would seem that the G.E. Library people have fallen down rather badly in marketing their service.

2) Therefore, a second reason why VC managers don't utilize more government reports is because some of the men simply do not know what services the G.E. Library offers to procure such data.

There are more, still more, reasons why the respondents were hesitant to use government information.

3) About 50% of the men interviewed felt that government data was not indexed conveniently. Complaints were frequent concerning the fact that they never received any summaries or abstracts of government information that is currently available.

Roughly 90% of all of the Visual Communications' requests for government data were for a particular report previously footnoted in either a paper presented at a professional conference, or a journal article. Virtually no primary search was undertaken.

4) Another frequent complaint about government data was that it was not concise and not complete.

Often contractees do not report completely the work they undertake for the government. It's to their advantage to report only the minimum information to meet the contract requirements. Consequently, the contract reports tend to describe how a company did A and how it did B -- but rarely does the report explain fully how they got from A to B.

5) The last major complaint concerns the time lag in government reporting. If a company is developing products with a market life of 3-5 years and the commercialization turn-around time is 2 years, then it doesn't pay a company to collect a lot of year old data.

Many of the contractees, according to the respondents, don't report their work until 6 months or a year after it is completed. At this rate it is not unusual for government data to be 1-1/2 to 2 years old before anyone gets a chance to see it.

Thus, one can conclude that government agencies, contractees, dissemination system, and the information marketers need a better approach in order to serve the commercial needs of product departments such as Visual Communications.

Interdepartmental contact could be an excellent source of technological information. Good communication could assure

a minimum of duplicated effort on behalf of the 160 G.E. product departments. Yet, as anyone can detect from the media rankings, formal contact between Visual Communications and other product departments is nill. The respondents reveal that practically all relationships between product departments are dependent upon the personal contacts of the employees.

The only exceptions to the lack of contact are the TAM-TAC sessions between defense oriented product departments. TAM-TAC sessions have been in existence for quite some time. The purpose of these annual and biannual meetings is to simply keep abreast of technology and what each product department is doing. Unfortunately, the sessions are not widespread among the product departments.

When the respondents in Visual Communications were asked whether or not they had ever heard of TAM-TAC sessions, or participated in them -- the following results were tabulated:

> 8 out of 10 men had never heard or participated in TAM-TAC sessions.

A partial explanation for this response might be that TAM-TAC sessions are generally attended by only top management of a product department. On the other hand, the top management should be disseminating information derived from TAM-TAC both horizontally and vertically.

Only recently, with the market pressure for automated

cameras, has Visual Communications been pressed into formal contact with other product departments doing work with telemetry.

One respondent was quite outspoken and emphatic about how to correct the problem of minimal product department contact and information exchange. He made the following statement:

> I think that there is a tremendous knowledge gap between product departments. There is a great amount of knowledge available right here in the company which we can't get our hands on. It has been my experience that the staff people at the division level don't get involved enough, don't push hard enough to make sure that everybody is fully coordinated and full informed.
>
> One of the problems here is the fact that we do not have a guy one level above the product department who really gets involved with what the product groups are doing..... This guy should be in the hair of every product planning manager for every product department in the company....

Implications - Media

To summarize the media analysis, one must ask: What are the immediate implications for Visual Communications?

1) A concerted effort must be made to insure that the Library staff will effectively market all the sources of technological information at its disposal. This should include indexes to government data, explanations about computerized dissemination systems such

as the DOD link-up, etc. A complete listing of media sources embraced by the G.E. Library should be available to every product department.

2) Methods of formal review should be initiated between product departments to maximize understanding, minimize duplication of effort and encourage information exchange and dissemination. Department people as well as Division people should continually monitor the work of the departments so that areas of interdependence can be made clear.

3) Efforts must be made to educate people in different functional areas about the information needs and sources of their colleagues. Communication and awareness should be at least good enough so a top manager will not fall into an information void. One respondent revealed the existence of such a void when he admitted that he had never heard of or used a TIS Report.

4) Information sources of all kinds should be made as readily accessible as possible. Good evidence from the media rankings exists to substantiate the fact that people end up using those media sources which are easiest to get ahold of.

Out of the media research at Visual Communications comes a hypothesis for future verification in the remaining part of the NASA study:

The technological media sources selected by each functional group will reflect three things:

1. The function to be performed (i.e., problem solving is state-of-the-art, etc.)

2. The state of technological development (i.e., new tech. vs. applications)

3. The state of market development (i.e., unsaturated vs. saturated)

and the utilization of selected media will generally depend upon ease of access.

2. Motivation Analysis

The second area for analysis is that of motivation. Comments by the respondents explaining the motivation for search and dissemination activity, regardless of functional grouping or business section, were divided among the following:

a) Professional pride and sincere desire to fulfill job responsibilities.

b) Because each man knows that part of his year-end evaluation made by his boss examines how well he

has pursued problems and taken advantage of G.E. facilities in attempting to solve them.

c) Monetary incentives (direct), such as awards for inventions or patents.

d) To make a favorable impression.[1]

- Eight of ten men cited both reasons a and b.
- Ten out of ten men cited reason a.
- Reasons c, d, were cited rarely.

As it turns out, responsibility to search and disseminate is one which is automatically acquired with any managerial or professional job at G.E. As one respondent very frankly put it: "That's one of the important things we pay a man for." However, the degree to which an employee does in fact search and disseminate seems to vary according to the type of superior a man has, the type of work a man is doing, the amount of free time he can make available, the peer group with whom he associates, the way he measures his relative success against others in similar positions, and whether a man has a good understanding of the kinds of information which are valuable to people in functions other than his own.

Frequently mentioned inhibitors to search and dissemination activities on the part of the professional or managerial

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[1]Additional comments and individual responses may be found in the Appendix.

respondents were from among the following:

a. job pressure and time constraints
b. superiors not motivated
c. restriction of information to maintain job security and expertise
d. an inherent confidence that the job could be done better, regardless of the completeness of outside technical information

The standard reply was that lack of time prevented the men from doing more search and dissemination of technological data. This reply is not untrue considering the pressure which builds up due to profit decentralization and accelerated new product introductions. Even though the time factor is a potent inhibitor and certainly frames the case for media selection by accessibility, there is another element of inhibition which was hinted at only twice -- but may have a powerful impact on search and dissemination activity.

Two of the respondents, one an engineer and one a marketing man, outlined some of their observations about how people approach their work. The generalist will in many instances have nothing specific to "hang his hat on" except the fact that he understands the way in which the total business functions. He knows a lot about every activity of the company. And by the nature of his job, he must maintain exceptional communication links

to all parts of the firm. He is generally better at dealing with people - motivating and communicating - than are very specialized men. The generalist does not gain anything by hoarding information or refusing to accept information from outside sources. He has become a generalist simply because he is an expert at utilizing and disseminating information he has received from sources other than himself. Any man in any profession can be a generalist in the sense that he has some of the forementioned characteristics.

On the other hand, the specialist is selling expertise. He is a focal point of knowledge about a particular subject. Much of his purpose is to become a source of information for the company. To lose the aura of authority would be to lose the title specialist. The specialist also never seems to generate much personal contact among people in other functions of the business. Associates of a specialist are usually in closely related fields.

Both kinds of men are needed in all functional areas of a business -- especially a decentralized business. However, it appears that the best men suited for search and dissemination of technological information are neither pure generalists, or pure specialists -- but a combination of both. Often the generalist will fail to communicate technical information to another functional group in specific enough terminology. This was one

of the complaints engineers had with marketing people at Visual Communications.[1] Likewise, the specialists seem to have an inherent tendency to play down external technological information in preference to their own authority.[2] Whether this tendency comes from an urge for creativity, or whether it is a natural protective reaction to maintain one's position of authority, the respondents could not say. One thing remained, both respondents had noticed that specialists, especially career-minded specialists, had a tendency to hoard information and not disseminate it.

Little is known about the effect of direct monetary reward for search and dissemination, because no company has experimented with it. General Electric relies on salary growth as a major motivator and relies on year end evaluations of employees to reveal improvement and success. There is a section in the evaluation which specifically asks the superior to evaluate the employee's ability to utilize G.E. facilities for problem-solving or general information search.

Motivation is a difficult thing to generate. Clearly, motivation is a key issue in developing both a good dissemination system and top management.

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[1]See Tillman interview.

[2]See Bias, Storey, and Lively interviews.

Implications - Motivation

The only conclusions this research can present to GE Visual Communications concerning motivation to search and disseminate is that it needs continual attention. It is not difficult to spot poor motivation within a company when one of the top managers says: "I've been with the Genral Electric Company for 11 years. I've heard of the dissemination system ever since I've been here, but I never once witnessed it in action.... And in those 11 years, I've been in quite a few places."

1) Motivation to search and disseminate technological information can not depend solely on each man independently developing professional pride and job responsibility.

2) Motivation requires motivated superiors, motivated top management, and an atmosphere which encourages and provides time for men to get enthusiastic about search and dissemination.

3) Motivation must be given a "shot in the arm" occasionally by financial incentives over and above normal salary progress.

4) Proper motivation, where it exists, must be recognized and applauded. Ill-founded motivation, as in the case of a specialist restricting information, must be routed out and corrected before it influences others to act accordingly.

Implications for the NASA research are:

1) A dissemination system must categorize summarize, and disseminate its information in such a way as to satisfy its customers. Information is essentially a product - and like any product, it must serve its market well. Failure to do this will create negative motivation on the part of the users. If more of the G.E. respondents had been pleased with their contact with government information, then I doubt that they would have ranked government information on the bottom of their media list.

2) Companies who do utilize financial incentives to motivate their men to search and disseminate technological information should be sought out in order to monitor the effectiveness of such incentives.

3) The specialist who is career-minded often has a tendency to restrict information flow when he should be doing the opposite. Restriction is usually undertaken to maintain expertise, authority, status, and sustain comparative advantage over other men. This kind of resistance will completely break down good internal dissemination within a company.

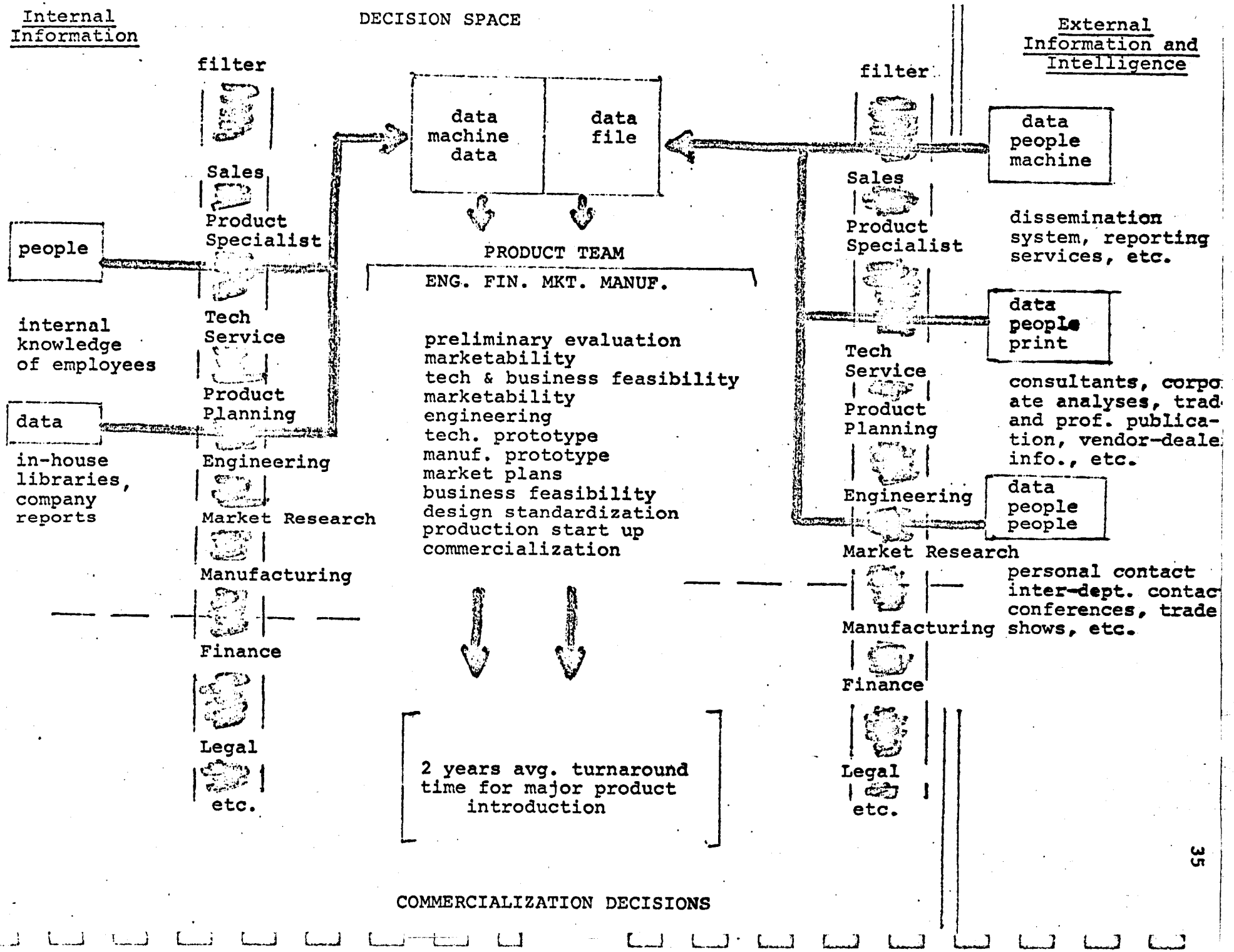
commercialization:

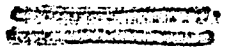
1) What are the decision-making steps in the commercialization process?

2) From which end of the spectrum do most of the development ideas come, i.e., stimulated by marketing uncovering a consumer need or by engineering developing a new technology or product?

3) At what point does marketing enter the commercialization process?

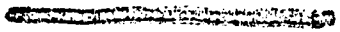
From the discussion about development in both the Broadcast Business Section and the Closed Circuit Business Section, it is possible to diagram the process as follows on page 35. Note, that information can enter the firm from external sources in only three forms: machine data, printed data, or by personal contact. In each case man has already processed the data in some way; subjecting it to perceptual distortion and bias. As the data is received by any one of the firms' functional groups it is again filtered and distorted; some of the data being thrown out and some being stored either on file or in data banks. It is at this point where proper motivation on the part of the men can make all the difference between having an efficient information network or one that is filled with too little or too much information.


Internal Information
DECISION SPACE
External Information and Intelligence
filter
data machine data
data file
filter
data people machine
Sales
Product Specialist
people
PRODUCT TEAM
ENG. FIN. MKT. MANUF.
Sales
Product Specialist
dissemination system, reporting services, etc.
internal knowledge of employees
Tech Service
Product Planning
preliminary evaluation
marketability
tech & business feasibility
marketability
engineering
tech. prototype
manuf. prototype
market plans
business feasibility
design standardization
production start up
commercialization
data people print
Tech Service
Product Planning
consultants, corporate analyses, trad and prof. publication, vendor-deale info., etc.
data
in-house libraries, company reports
Engineering
Market Research
Manufacturing
Finance
Legal
etc.
data people people
Engineering
Market Research
personal contact inter-dept. contac conferences, trade shows, etc.
Manufacturing
Finance
Legal
etc.
2 years avg. turnaround time for major product introduction
COMMERCIALIZATION DECISIONS



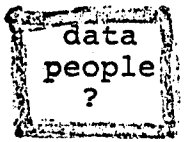
double line is company boundary

dashed line is feedback



solid line is information and intelligence flow

zig zag line is distortion as caused by perceptual differences, number of transmission points and media transfer



the boxes represent data manipulation combinations - in all cases people first acquire the data. It then may be processed into print or machine language.

Information is not only accumulated from external sources, but also internal ones. Filtering is again undertaken by the functional groups processing the data. Distortion can be even greater internally since influence, authority, political power, etc., can be used to mold data to suit the ends of its processor.

The notion of distortion is important enough to warrant a brief digression. Distortion is the impairment of pure information flow by the fact that:

1) the perception and frame of reference of the sender is never exactly the same as the perception and frame of reference of the receiver.

2) because the environmental barriers obscure and reshape the message as it travels over a greater number of transmission points.

3) because in the transfer of information from one media to another, oftentimes, some of the pure input is lost, i.e., voice to print.

Distortion is primarily caused by human error and human perception bias. Generally, people pass on favorable information regarding themselves and hold back unfavorable information. Prejudice and perceptual differences between men, especially men in environments with different goals (i.e., manufacturing vs. marketing or subordinate vs. boss), will cause one to consciously and unconsciously filter information.

The objective of a good, internal dissemination system is to reduce the number of transfers of information with minimum distortion and at the same time retain only the pertinent information.

Returning to commercialization, information which is retained by the company does not have to be immediately filed or stored. Bits of information which look like especially interesting commercial ideas are frequently sent directly to Product Planning or to the Product Manager who can utilize the information. The Product Manager heads up a Product Team consisting of marketing inputs, engineering inputs, manufacturing, finance and any other inputs which are necessary for good management of the product. During new product development, the chairmanship of the team may rotate depending upon the stage of development.[1] Normally, however, in both the Broadcast Business Section and the Closed Circuit Business Section the Product Managers are marketing men.

The commercialization stages listed under the Product Team represent the formal steps taken to get a major product introduction under way. In actuality, the process is not quite as organized as pictured diagramatically. A lot of the evaluation is done informally and in a more random fashion. Several of the marketing managers, including the Product Planner, would like to see a more formalized commercialization process and have

---

[1] See Tillman's interview.

made this one of their long range objectives.

Turnaround time for the commercialization process from beginning to end is about two years for a major new product. However, a small improvement can generally be pushed through in a couple of months if necessary. In such a case, the stages listed on the diagram would be considerably abreviated.[1]

Throughout the interviews at Visual Communications several examples of product development were cited. Development ideas can come from almost any part of the company. Mr. Storey, Marketing Manager of the Closed Circuit Business Section, mentions a product improvement which was initiated through customer contact. Mr. Peterson, of the Broadcast Business Section, mentions a product development example stimulated by engineering. He also cites a case when a key competitor, Philips, introduced a new color camera at an industry trade show several years ago. G.E. did not have a similar camera at that time and so immediately went into a crash development program, solely on the basis of what they saw and heard at the trade show. Within one and one-half years, G.E. had a competitive product on the market.

The frequency and early intrusion of the marketing input in the commercialization process is easily noticed on the diagram. This researcher feels it fair to say that based on the interviews it appears that the earlier marketing enters the commercialization

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[1]See development example in Mr. Storey's interview.

process -- even at the information gathering stage -- the faster turnaround time.

There were differences in the development efforts undertaken by the Broadcast Business Section and Closed Circuit. Some of these differences have already been accounted for. The Closed Circuit unit spent relatively more time on new applications than did the Broadcast unit. Factors such as technology development, market development, price elasticity, etc., accounted for the difference in emphasis. The Closed Circuit unit seemed a bit more responsive to problems than did the Broadcast unit. This may be accounted for by the dramatic difference in size between Broadcast and Closed Circuit.

The technological direction was most often stimulated by the marketing side of the business in the Closed Circuit unit. The Broadcast unit got many of its development ideas from engineers. This pattern fits in with the market approach of each section. Diagramatically, the development stimulant spectrum could look like the following:

DEVELOPMENT STIMULANT SPECTRUM

MARKETING	Closed Circuit	Broadcast Section	ENGINEERING
customer sales tech service product planning			engineering design manufacturing
		Product Manager and Product Team	
applications oriented			technology oriented

Implications - Commercialization

The only implications of this research which relate to Visual Communications and the commercialization process concern the relatively informal nature of communications between business functions, and the relative indifference of the respondents toward the activity of other product departments. More than one engineer commented that he felt V.C. was number one in the industry and therefore had little need for technological information from outside sources. Yet the need for continual contact with any and all product departments who can aid technology development at Visual Communications is no more obviously apparent than at the present. The marketing people have detected a strong need in the marketplace for automated equipment which they claim to have anticipated one or two years ago. Even now, Visual Communications contact with military product departments long on experience in telemetry is only informal.

Therefore, the following implications apply to Visual Communications:

1) There is need for formalization of the critical communication channels between business functions who actively participate in commercialization.

2) Formalization of the commercialization evaluation stages will allow all business functions to know what information is necessary for routine new product

evaluation, and what information is needed by each functional group in order to carry out its end of the operation. (Formalization does not imply rigidity or sluggishness. On the contrary, what it should provide is a clearer, sharper picture of development.)

3) The commercialization process should be well enough defined so that every functional manager would know exactly where and to whom he should disseminate any kind of important information he should encounter. The interviews did not reflect that level of definition.

4) It would seem that formal evaluation of risk would play a significant role in determining how much time and money to allocate for search and solution of a development problem -- not to mention the importance of risk evaluation in making a decision about commercialization itself. Yet, several respondents claimed that virtually no account was made of risk. Therefore, risk analysis might prove useful in the allocation of development monies.

The following hypotheses relate to the NASA research and the commercialization process:

1) In the decentralized, P & L, market oriented businesses, the pressure on personnel to be continually thinking

in terms of commercialization means that they will have minimal time for search and dissemination of technological information. The tendency for this kind of company will be to monitor more state-of-the-art information and applications information, than raw technical data -- leaving the latter job for a support R & D group or a corporate R & D Lab. The government dissemination of tech. information must be divided up to reflect this division of search and dissemination activity and marketed accordingly.

2) Because of the time perameters placed on the decentralized commercial firms in high technology businesses, government dissemination agencies should mark all information clearly with an estimate of data age, i.e., the date research was undertaken, the date research was completed, the date on which the report was submitted to the government agency, the date the report was published and available for dissemination. In this way, useless information will not reach the company and waste the time of personnel or impair the image of government dissemination agencies.

3) Marketing is especially important to decentralized product departments such as those found at G.E. The diagram of the commercialization reflects the importance of the marketing input. It appears that the earlier marketing personnel get involved with the commercialization process, the faster the turnaround time.

4. Costs

The fourth section of this research concerns the costs of undertaking search and dissemination activities at Visual Communications. Only by careful cost analysis in twenty to thirty companies in several diverse industries, can a reasonable estimate of search and dissemination expense be compiled. Then and only then can a government computerized dissemination system be designed to offer real value to the companies requesting data. The trade off between the time within which a company must acquire certain data, the cost of searching for that data, and the cost of actually producing the desired data -- is the dilemma facing decision-makers watching over the commercialization process. An efficient dissemination system could reduce the costs of search considerably and in many instances eliminate the cost of doing research that had been previously done elsewhere.

Thus, the potential of such a system is very real indeed; provided the problems of redundant and latent data are overcome.

Using the data generated in the interviews at Visual Communications, costs were broken down into three basic areas:

1) Personal time cost.
2) Other costs related to personal time.
3) Departmental costs.

Personal time costs were based on the percent of time each interviewee estimated that he spent in search and dissemination over the year. Because, by the nature of this study, it was impossible to interview every manager, the time estimates were averaged for each major function group. The percentages were then applied to the combined salary totals of all managers and professional personnel in a position to undertake search and dissemination in order to estimate the personal time costs by functional breakdown. It must be assumed that the gentlemen interviewed represent a fair cross-section of functional managers.

The second group of costs are mainly travel and living expenses associated with attending conferences and trade shows, consulting fees, patent search fees, etc.

The third group of costs cover all expenses paid for by the department which directly relate to search and dissemination of technological information: library assessment, a percent of trade show costs, education and tuition payments, departmental

product evaluations or consulting fees, subscriptions, R & D assessment, and other purchased development.

The summary of these costs appears below:

I. Personal Time Costs

Est. Salary Totals	Function	% of Time	Est. $
220,000	Engineering	11%	24,000
240,000	Marketing	21%	50,000
225,000	Manufacturing	4%	9,000
20,000	Patent Counsel	1-1/2%	300
90,000	Closed Circuit Business Sec.	15%	14,000
975,000	Total		97,300

II. Other Specific Costs Related to Personal Time Above

Travel and Living Related to Conferences, etc.

Engineering	5,400
Marketing	9,000
Manufacturing	5,400

Consulting Services by Function

Engineering	10,000
Marketing	
Manufacturing	
Patent Searches	1,000
Total	33,800

III. Departmental Costs

Library Assessment	2,000
Trade Show	60,000
Education and Tuition	22,600
Product Evaluation or Consulting Fees	
Library Subscriptions	
Gen. Company R & D Assessment	85,000
Other Purchased Development	50,000
Total	219,600
Grand Total	350,700

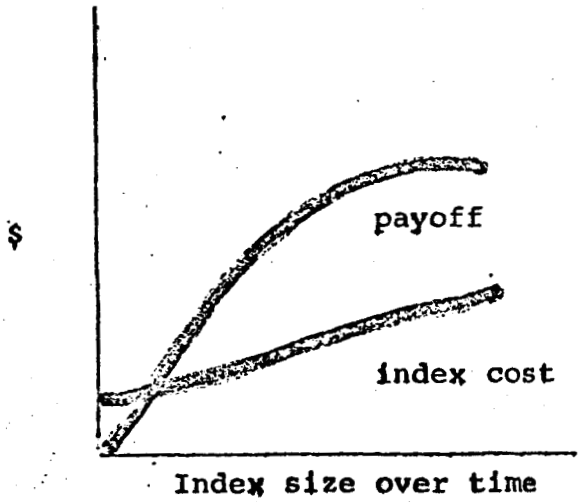
The only real problem with these estimates is that there is no available data on sales or earnings by which to compare these figures. Mr. Brooks did provide estimates of total salary figures broken down by function. Using these, one can note that the total cost of managerial and professional time spent in search and dissemination of technological data is approximately 10 percent of total estimated salaries.

It should be noted that the highest percentage of time is spent by marketing personnel -- not engineering as one might suspect. This fact can be accounted for in part by the way in which "technological information" was defined in the beginning of this report, by the fact that Visual Communications is marketing-oriented, and because some technical specialists have a

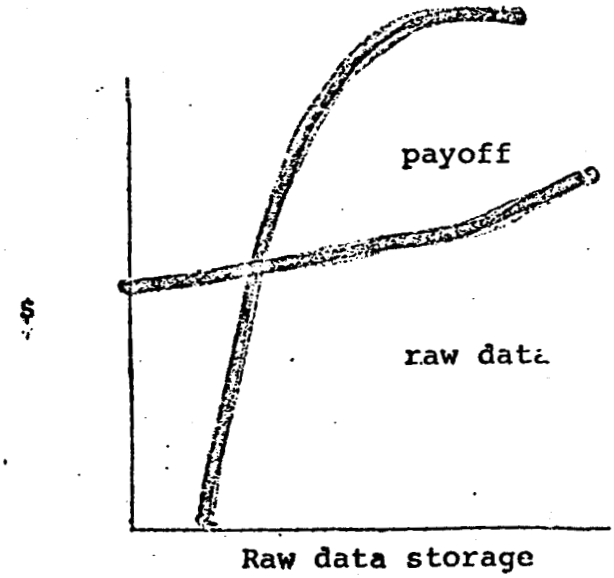
tendency to restrict information flow for their own personal benefit.

Closed Circuit management spent slightly more time on search and dissemination than did B.S. This is mostly because the Closed Circuit unit is much smaller than the Broadcast Section and both engineering and marketing men have some responsibilities which overlap.

It was discovered in one of the interviews that in a competitive industry there is a tendency for decentralized P & L units such as V.C. to buy ready processed information (technical, competitive, performance). The reason for this was the time constraints imposed upon management by the marketplace. Subsequently, it was discovered that the utility of indexes for information was far greater per dollar than anyone had anticipated; especially at low levels of expenditures. In other words, the purchase of indexes has a high dollar payoff when you can afford the time to undertake the data search yourself. The graphic representations of both index cost and raw data cost appears below:



Index size over time



Raw data storage

At least one other important cost has been left out of consideration. There is a tremendous opportunity loss in undertaking research that has been done before somewhere else in the company, etc. Unfortunately, there is no way to know how often reinvention occurs.

In the interview with Mr. Brooks, Financial Manager for Visual Communications, the subject of financing development was brought up. As one might expect, development is financed purely out of current funds. No capitalization is possible. Mr. Brooks also emphasized that there are exceptions to that rule. In the case of a long range product which requires a considerable amount of start up capital - the mother company will help out.

Most of the financial control at Visual Communications is through budget. As long as each business section, each section and subsection meet their budget -- everyone is happy.

Occasionally, extra development work, over and above research being financed through department R & D assessment, will be purchased from the R & D Center.

Implications - Cost

There are several implications for Visual Communications which come from the cost section of this research:

1) The purchase of indexes to information have a higher return/dollar than the purchase of processed raw data

in those cases where the company can afford to do the data search themselves.

2) Considering the fact that government information is free, it seems reasonable that a company should make sure it understands what kinds of information are available and how to get it. If any portion of the government information is useful, it will automatically become the cheapest data to acquire.

3) With approximately 10 percent (on the average) of a functional manager's or professional's time going for search and dissemination, it would be reasonable to try and implement the most efficient internal dissemination system possible.

Implications for the NASA study are:

1) Data bank computerized dissemination of information bears such economies of storage, access, and manipulation that it should be extremely useful to any company if it can be categorized quickly and properly. Computerized dissemination offers the advantages of both indexes and processed raw data.

2) A dissemination system which featured applications and development oriented information could cut commercialization time. Essentially an effort similar to the one undertaken in the bio-medical applications field would be required.

5. Additional Comments

In summary, the respondents were asked to comment on whether or not they felt that the government had a responsibility to disseminate its research information and whether there would be any significant fallout from it? About 50 percent of the respondents felt that extra justification for large DOD and NASA expenditures was not necessary because the funds were being spent in the interest of national security and world prestige. The remaining people were quite quick to answer that the government definitely does have a responsibility to get maximum mileage out of its research information.

Regarding the second question, there was little dissent about fallout. Most all of the respondents felt that everyone was expecting too much fallout -- too fast. The respondents emphasized the great void between the high reliability and performance development of the government and the less sophisticated commercial development. Applications, they say, will come in greatest numbers about 10-15 years behind current DOD and NASA work.

I shall close by reminding the reader that the purpose of this study was not to evaluate Visual Communications, but to develop a set of characteristics for Visual Communications. Implications and comments contained herein about Visual Communications are included as a by-product only. In that light, I respectfully submit this research.

APPENDICES

NAMES, TITLES, AND ADDRESSES

OF THE INTERVIEWEES

NAMES OF INTERVIEWEES

Syracuse University NASA Project

Visual Communications

Mr. F. J. Bias
Manager of Engineering
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. W. T. Tumber
Manager of Shop Operations
Visual Communications Products Dept
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. R. E. Putman
Manager Audio/Video Design Engineering
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. S. W. Cole
Manager of Engineering - Closed Circuit Business Sect.
Visual Communications Products Dept
General Electric Company
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. J. T. Tillman, Jr.
Manager Audio/Video Design Engineering
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. L. M. Storey, Jr.
Manager of Marketing - Closed Circuit Business Sect.
Visual Communications Products Dept
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. R. D. Peterson
Manager of Product Planning
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. P. D. Brooks
Manager of Finance
Visual Communications Products Dept
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

Mr. O. A. Lively
Manager of Marketing Research
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

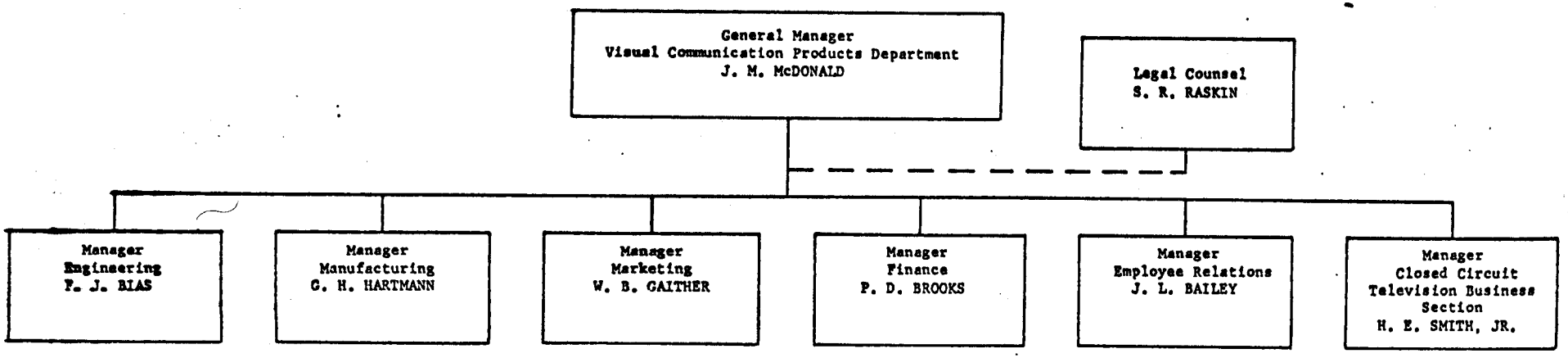
Mr. Thomas Spencer
Director of Library Services
General Electric Co.
Electronics Park
Syracuse, N. Y. 13201

Mr. M. R. Duncan
Manager Customer Service
Visual Communications Products Dept.
General Electric Co.
Electronics Park - Bldg. #7
Syracuse, N. Y. 13201

CONSUMER ELECTRONICS DIVISION

VISUAL COMMUNICATION PRODUCTS DEPARTMENT

STRUCTURAL ORGANIZATION CHART



Manager -
Audio/Video Development
Engineering
R. E. PUTMAN

Manager -
Audio/Video Design
Engineering
J. T. TILLMAN, JR.

Manager -
Transmitter Engineering
W. F. GOETTER

Manager -
Support Engineering
M. T. REESE

Manager -
Manufacturing Engineering
R. J. BURKE

Manager -
Quality Control
P. R. WATSON

Acting Manager
Materials
G. H. HARTMANN

Manager -
Shop Operations
W. T. TUMBER

Manager -
Broadcast Sales
R. E. LAUTERBACH

Manager -
Field Sales
T. F. BOST, JR.

Manager -
Customer Service
M. R. DUNCAN

Manager -
Industry Relations
J. WALL

Manager -
Product Planning
R. D. PETERSON

Manager -
Overseas Business
Development
R. W. COCHRAN

Manager -
Marketing Research
& Planning
O. A. LIVELY

Manager -
Advertising & Sales
Promotion
P. F. SCHONEWOLF

Manager -
Accounting
D. H. WILMOTH

Manager -
Business Systems
J. A. MOORE

Manager -
Credits & Collections
V. R. WIEBUSCH

Specialist -
Budgets & Measurements
A. C. BELANGER

Accountant -
CCTV
D. L. FELKER

Manager -
Union Relations &
Communications
L. J. TOOLE

Manager -
Employee Compensation &
Benefits
G. W. FREEBORN

Manager -
Personnel Practices
W. J. RUDGE

Manager -
Professional Relations
& Programs
R. K. BULLOCK

Manager -
Marketing
L. M. STOREY, JR.

Manager -
Engineering
S. W. COLE

Acting Manager -
Manufacturing
H. E. SMITH, JR.

Employee Relations
January 1, 1968

3. The manner in which the technological information gets absorbed into the commercialization or new development process.

4. Lastly, a rough estimate of the percent of time spent in search and dissemination, including the number of trips made to trade shows and professional conferences.

5. Other relevant comments made in the course of the interview.

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1. The respondents attempted a media ranking from the following:

TIS (Technical Information Series - GE)
journals: trade
journals: professional
R & D lab reports
electronic lab reports
trade shows
customer contact
in-house conferences (GOSAM, TAM-TAC)
personal contacts in and out of house
patent and licensing information
consultants
other product departments
government technical literature
GE library
Department library
supplier catalogs
vendor information
dealer information
foreign liason offices
corporate analyses

Mr. Bias felt that the following media were most frequently used (in descending order)

- R & D Lab - TIS reports
- Bell Lab Reports
- GE Library
- professional and trade journals
- government reports
- other GE product groups

Mr. Bias also remarked that he was not aware of the DOD link-up with the GE Library System, but he had participated in TAM-TAC sessions. Mr. Bias felt TAM-TAC was too defense-oriented.

Additional comments by Mr. Bias concerning media follow:

The local Electronics Park library do two things as far as we're concerned; they acquire current literature (books, periodicals, trade journals, etc.), and put out listings of their acquisitions. They have an extremely extensive periodical section which is slightly electronics-oriented. They also have an extensive file of government reports.

All these media are important to us from the development standpoint, however, becoming less important. Take circuitry design, for example, There are definitely a

INTERVIEW SUMMARIES - VISUAL COMMUNICATIONS

VISUAL COMMUNICATIONS

Interview Summaries

Name: Mr. F. J. Bias

Title: Manager of Engineering

Job Description: In Mr. Bias' words:

Part of my job is being able to determine which way this business is going. Part of my imputs are from engineering, part are from customers. Unfortunately, both of these are only of limited judgment. For example, with regard to the customer. He will be asked, "Would you like a hand held camera that was remote and could be operated through your system by telemetry?" "Oh, yes. We'd love that," replies the customer.

The only thing that tells us is something about the customer's basic needs. To develop such a camera we shall have to make a trade-off decision -- sacrifice reliability and picture quality for the portability and telemetry control feature.

It's part of my job to think about directing technology in the long-range. And in these rare moments when I have enough time, I'll sit back and think about new applications, new kinds of technology or some of the new variables which will become important in our business.

We write up specifications for the design of the product on paper. We give this paper to a managerial group for evaluation and then the manufacturing people will implement.

We essentially exist so that we can present manufacturing a set of instructions by which a product is created hopefully a product which is created that solves problems, serves a need, fills a market.

Major focus of the interview:

1. The types of media most frequently used to acquire technological information from sources outside the company.

2. The motivational stimuli for those who receive or search for technological data to pass it on to a colleague or store it for future use.

finite number of circuits which can be designed. Circuitry, we know, has a finite limit. To the degree that we approach the limits of circuit design, the only way to differentiate products will be on the basis of function, beauty, and miniaturization.

The next technological advance which is going to have major influence on circuits is going to be the integrated micro-electronic circuits. These are wonderful circuits. However, the materials and the cost in developing these is extremely high. Therefore, the first place where these applications are being found is in the military.

The next application will be in the consumer market -- not the industrial market. The consumer market is large enough and offers enough mass production potential, so that the costs of the integrated circuit will be brought down.

The last group which will get the benefit of these circuits will be the industrial user who will, of course, require a little more specialized equipment.

All of the industries are gradually approaching standardized circuit designs which produce optimal performance, very little heat, and are quite miniaturized. In this respect, you can be assured that in the future competitors will be producing very similar circuits.

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2. The respondent's comments about motivation for search and dissemination activity were based on one of the following reasons:

    1. Professional pride and sincere desire to fulfill job responsibilities.

    2. Because each man knows that part of his year-end evaluation made by his boss examines how well he has pursued problems and taken advantage of GE facilities in attempting to solve them.

    3. Monetary incentives (direct), such as awards for inventions or patents.

    4. To impress someone.

Mr. Bias answered in the following way: 1, 2, 4.

The greatest inhibitor to better motivation was cited as one or more of the following reasons:

1. Job pressure and time constraints.

2. Superiors not motivated.

3. Motivation as high as can be expected.

4. Dissemination inhibited in order to maintain job security and expertise.

5. Inherent professional unwillingness to accept wholeheartedly someone else's research.

Mr. Bias answered in the following way: 1, 2, 4, 5.

Additional comments by Mr. Bias follow:

Concerning motivation, the fellows in research and development better write up information reports since that's what they're getting paid to do. The engineers under me will be motivated out of professional pride and also out of an eagerness to impress their superiors that they are contributing in some way.

---

3. The following comments by Mr. Bias concern the commercialization process. Three basic questions were asked, but not always answered:

1. What are the decision-making steps in the commercialization process?

2. From which end of the spectrum do most of the new development ideas come, i.e., stimulated by marketing uncovering a consumer need or by engineering developing a new technology or product?

3. At what point does marketing enter the commercialization process?

The following remarks are by Mr. Bias:

Allow me to first give you some background information. There are some very definite restrictions on innovations in this business. We have a regulatory agency -- the F.C.C. -- who must, because of the lock-and-key arrangement of the components which go into a broadcast system, provide an overall specification for equipment performance and interchangeability.

Then, of course, the manufacturers themselves have had to slice down this block of overall tolerances issued by the F.C.C. into smaller more manageable pieces which they focus on in their separate businesses.

There are tolerances between the point of transmission, the point of amplification, the antenna, and the retransmission to sets in the receiving area. All of these interfaces have tolerances within which they must work. Otherwise, the system will not function. The problem may be further complicated by the fact that the studio may be in Hollywood or on a street or in a hotel or in a kitchen or in one's home. Therefore, the degree to which the signal is first recorded mobilly means that there are certain of mobile units, also.

The television system as you currently know it is terribly redundant. It could be made much more simple in its operation. But because there are some 90,000,000 receivers out we can't change them for better transmission. The television pictures we transmit today have a tremendous amount of redundancy. The color elements of a picture don't readily change, except where there is movement or where there are shadows. To that degree, we could cut out the redundancy of our system by developing a pick-up tube which would transmit only the changes in color, holding fixed (at the receiver level) all portions of the picture which do not change (color movement, darkness or lightness).

Therefore, we aren't making television now half as well as we know how to. The reason for this is partly economic and partly because we're locked in by our present system.

The significance of all this is that the development work done in the broadcast business consists of mostly product features, product refinements, and product reliability, and miniaturization.

Another perameter to innovation is the fact that there is a real advantage to the customer to continue doing things the way they've always been done. He is essentially selling time, and the degree to which his people know how to operate his equipment and know how to make maximum use of their time, he makes money.

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4. The following data relates to the percentage of time Mr. Bias and his men spend in search and dissemination of technological information over a year. Also included are estimates of the number of trips made during the year in order to attend trade shows, trade and professional conferences.

   Percent of time in search and dissemination of technological information?

   2 5 8 (10) 12 15 18 20 22 25 25+

   Average number of trips taken by managerial personnel in your section over a one year period in pursuit of tech. information?

   - three to four conferences a year

   - each man should be able to attend one.

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5. Additional comments by Mr. Bias:

BOB: Could you comment on the degree to which you're satisfied with government information?

BIAS: Very few of the people doing the write-ups for government reports have a concept, a true concept, of the constraints placed on the commercial producer. Economics is a real factor in our business. Most of the things that are written up for the government are written up without regard to our economics and this is the factor which determines if we can apply their information.

Basic research is not really the point of interest for a product department. It's applications research and secondary research that is important. In many instances, the applications which government reports sight are exotic and are far-reaching that they can't be applied to anything but warfare or space. There are very few instances in which direct space research can be applied on a commercial basis.

A lot of the space researcher engineers start with a concept, an ideal concept and work their way towards some bit of hardware.

In our business, we start with the hardware. We know what kind of hardware we have to work with, and then we build up towards a concept. So somewhere in-between is where space technology and the commercial business meet.

For example, the pick-up tube operation is probably the real frontier as far as broadcasting and television go. We already have the technological imput to design circuits to amplify light and do all kinds of things with the image after it's been turned into electronic impulse. The pick-up tube operation is that critical link which changes light into electrical energy. This is a very critical step and this is a step which the new frontier will be based on. This is where I'm putting my research money. I'm actually taking money out of my section profit, so to speak, and turning it over to another product department who is running the pick-up tube part of the business. I hope that through the additional funds that we might get ahead of our competitors. It is obviously to my advantage to do this, but I have a little difficulty in persuading top management my investment is wise since there is not an immediate pay-off for several years.

If I might add one other comment, I feel that I s-ould say something about the potential to which information can be transferred from military to commercial.

I've been working for General Electric for twenty-five years and I've been involved in the military and the commercial side of the business. I feel that people vastly overrate the degree to which technology can be

transferred from military use to commercial use. There's not a bigger trap in this world, in my way of thinking. The potential is not there.

I feel there are a lot of government researchers who are doing very little high-level theoretical research who are trying to sustain their jobs by justifying them on the basis of fallout. Actually, it's a very, very difficult thing to do. I think they're better off justifying the good research on the basis of national security, national prestige, world prestige, and the ability to provide some kind of threat to the onrush of communism.

This country was founded on a major expenditure of national wealth for defense and research to maintain world position. But to sit and justify all expenditures on a basis of fallout, something you can't measure, is very touchy indeed. I think if we get to the state of affairs where we have to justify too much then we're going to be jeopardizing our own security and world prestige in the process.

BOB: Is there any advantage to bigness?

BIAS: Probably the only advantage is in the acquisition of information. We can go to the phone and literally call an expert in any particular field and have him at our disposal quickly. He can usually put us on the track of all kinds of informational sources which are very up-to-date.

VISUAL COMMUNICATIONS

Interview Summaries

Name: Mr. R. E. Putman

Title: Manager of Audio-Video Development

Job Description:

The following interview is with Mr. R. E. Putman, Manager Audio-Video Development Engineering, for the Visual Communications Product Department. Prior to the actual interview, some background information about Mr. Putman might be useful. Mr. Putman is essentially a self-made man having no college degree, however,upon the authority of others in the Visual Communications Product Department, Mr. Putman is at the pinnacle of his field serving on many national committees involved with the standardization and specification of broadcast equipment. He has reach the height of his field through diligent and practical effort within the General Electric Co. He is a career General Electric employee. Mr. Putman has been assigned a task supplementary to his job requirements which essentially is one of developing a glossary of terms to bring the film industry and the broadcast industry closer together. Recently they have experienced extreme frustration. Needless to say, much of Mr. Putman's comments are of a practical nature. He values very highly a man who has done technical work as opposed to one who theorizes. Mr. Putman's job revolves around the design of current products.

Major focus of the interview:

1. The types of media most frequently used to acquire technological information from sources outside the company.

2. The motivational stimuli for those who receive or search for technological data to pass it on to a colleague or store it for future use.

3. The manner in which the technological information gets absorbed into the commercialization or new development process.

4. Lastly, a rough estimate of the percent of time spent in search and dissemination, including the number of trips made to trade shows and professional conferences.

5. Other relevant comments made in the course of the interview.

1. The respondents attempted a media ranking from the following:

TIS (Technical Information Series-GE
journals: trade
journals: professional
R & D lab reports
electronic lab reports
trade and professional conferences
trade shows
customer contact
in-house conferences (GOSAM, TAM-TAC)
personal contacts in and out of house
patent and licensing information
consultants
other product departments
government technical literature
GE library
Department library
supplier catalogs
vendor information
dealer information
foreign liaison offices
corporate analyses

Mr. Putman felt that the following media were most frequently used (in descending order):

- personal contact
- R & D reports
- TIS
- professional conferences
- licensing and patent information
- government reports

Mr. Putman remarked that he had not heard of the DOD link-up with the GE Library System, but had participated in TAM-TAC sessions.

Additional comments by Mr. Putman appear below:

BOB: Of all the sources available to you here in the visual communications products department, which of these sources of technological information are most useful to you?

PUTMAN: Informal contacts with other people are a great source of information to me. There are also a number of committee meetings which are industry wide which monitor a good cross-section of the industry. In these professional meetings, however, it is difficult to find out specific information. But in terms of discovering where you are in relation to other companies within the industry, the conference is a good source.

Technical papers presented by members of a professional society are also valuable sources of external information. Trade journals and professional journals are fairly adequate sources of outside information - the only reservation being the lag in the reporting. In general I feel that I know what is being done before it hits trade and professional journals and if I did not know this I wouldn't be doing my job.

BOB: How would you characterize the communication between different product groups? Is it formal, informal, rigid, free, structured, bureaucratic, etc.?

PUTMAN: I guess I have never had any problems. It's merely a matter of picking up the phone and looking in the directory to find the name you wish to contact. General Electric has an unusual advantage of a telephone link-up which allows you to dial any man in any product department right from your desk with only four numbers. This is a great convenience to me personally. I would say that within the company there is extremely good communication if and I underline if the people care to use it. You have to initiate the contact. Nobody is going to bring you information.

BOB: What about your use of library facilities?

PUTMAN: We use it all the time. The library within the company is an extremely fine set up. I feel the time lag between when the request is made and the information is received could be reduced, but it's understandable. The lag is currently anywhere from a day to about ten days. If this library facility here does not have the information, most of the time anything can be found at the larger library in Schenectady.

BOB: Would it be fair to say that you already have in mind some piece of information you wish to find when you contact the library? In other words you do very little primary search - mostly secondary search and dissemination.

PUTMAN: Yes, we do very little primary searching. It's mostly all secondary. In general, we are product oriented. We know our own field, the necessity for primary search is not as evident here as it would be in other product groups. I, personally, have one advantage in that I write a report annually which covers the world of broadcasting and film. So I am perhaps more informed than others about what is happening in the industry.

BOB; Some years ago formalized sessions code-named by TAM and TAC were initiated in the General Electric Co. with the primary mission being to aid the communication between product departments so that each one knew what the other was doing. Could you comment on this please?

PUTMAN: Yes, I was involved in these programs. They are currently still running. They are held on a rather high level. Approximately six years ago there was the Advanced Development Council for the Exchange of Information in the various departments in the Defense Division, I underline Defense. At that time it was pretty much limited to Defense. Groupings were broken down into about 14 categories beginning with new products and materials right through to finished product applications. It is run on the basis of a panel. Currently, around 14 panels evaluate the work of the various product departments, Each panel specializes in a given area. Each panel will normally meet a number of times during the year, a minimum of one, but normally twice.

It's beneficial in the sense that you try to counter re-inventing the wheel again. Let me qualify this now. Let's take a young engineer fresh out of school. I'll be perfectly frank, you've got to now and then re-invent the wheel, you've got to let him have that challenge. You can't tell him that it won't work; he is convinced in his own mind that he can do it. You've got to let him discover the truth one way or another. You don't dare stop the initiative of the individual. So you have to have some re-inventing.

PUTMAN: I was recently at a professional conference out on the West Coast and I guess I filled a reel of tape while I was there monitoring what was happening, what was going on. I passed it freely around to all the people here when I got back. This kind of thing is very difficult to put a 'time' on. In this case, the tape machine is in my room, I can dictate between meetings.

BOB: Then you feel this professional meeting you recently attended would be a valuable source of information concerning how you stand within the industry and in what ways technology is moving in the industry?

PUTMAN: Oh yes, definitely.

BOB: What about the trade snow?

PUTMAN: It is of value as far as keeping abreast of industry and answering questions of general knowledge. But as far as answering any specific technological question it of course does not do this.

BOB: Do you utilize government reports in the acquisition of technology?

PUTMAN: I guess I'd say very little. Going back again to the example of telemetry. NASA has done probably the most work in this field. Therefore, where did we go to find out about it? We called light military, heavy military and one of the space divisions and asked who down there knows anything about telemetry. We got four or five leads from there. We did not go to government reports because we wanted the most up-to-date information at minimum effort.

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2. The respondent's comments about motivation for search and dissemination activity were based on one of the following reasons:

    1. Professional pride and sincere desire to fulfill job responsibilities.

    2. Because each man knows that part of his year-end evaluation made by his boss examines how well he has pursued problems and taken advantage of GE facilities in attempting to solve them.

    3. Monetary incentives (direct), such as awards for inventions or patents.

4. To impress someone.

Mr. Putman answered in the following way: 1, 2.

The greatest inhibitor to better motivation was cited as one or more of the following reasons:

1. Job pressure and time constraints.

2. Superiors not motivated.

3. Motivation as high as can be expected.

4. Dissemination inhibited in order to maintain job security and expertise.

5. Inherent professional unwillingness to accept wholeheartedly someone else's research.

Mr. Putman answered in the following way: 1, 2, 5.

Additional comments by Mr. Putman appear below:

Motivation is basically a function of the individual. Some people have the information and they gladly give. Other people restrict its flow and do not attempt to pass it on.

BOB: Is there any monetary motivation to pass on information?

PUTMAN: No, no monetary motivation. Let me remind you that the passage of information is essentially always a two-way street. Should you pass information on to someone else, you would expect at some future date, if not right away, that you might be able to get some information back. For example, we have a group down in Utica which is designing cameras specifically for the military. The work they are doing is classified. Yet there is a fair exchange of information between our Visual Communications group and theirs. Granted they can't tell us what they're doing and we don't ask, but they will show us the products and we do discuss general problems. And we both respect each other. So you do have an exchange of information under the condition that to get something back you must give.

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3. The following comments by Mr. Putman concern the commercialization process. Three basic questions were asked, but not always answered:

1. What are the decision-making steps in the commercialization process?

2. From which end of the spectrum do most of the development ideas come, i.e., stimulated by marketing uncovering a consumer need or by engineering developing a new technology or product?

3. At what point does marketing enter the commercialization process?

Additional comments by Mr. Putman appear below:

BOB: In characterizing the product development that is going on in the Closed circuit unit as versus the regular Broadcast Unit would it be fair to say that in Closed circuit they are searching for new applications to existing technology, where in the Broadcast business they are continually concerned with new technology?

PUTMAN: I don't feel that there is that rapid a change in technology in either product group. Change in technology is one of evolution not revolution.

BOB: Can you give me an example of competitive stimulation of development?

PUTMAN: Yes, back in 1959 the Europeans introduced 4½ inch camera. At this point neither RCA nor General Electric had changed their camera designs since 1952. So the Europeans came in with the world's best camera. To be perfectly frank, they completely took the lion's share of the U.S. market right out from under us. And so RCA and GE had to go like mad. Up until that point there was no real pressure to do anything, so we were complacent.

BOB: How would you characterize the difference in competition between the Closed Circuit and the market for general broadcast equipment?

PUTMAN: It's different because of the market differences. I personally don't necessarily agree with the Closed Circuit people, I do not feel it's a price market, I feel it's a reliability market and price is secondary. The closed circuit market is split up, of course, among 20 different companies. Motorola has gone after the system work. RCA is after system coupled with higher-priced units.

BOB: Do you feel that this emphasis on price by General Electric is in the hopes that this product will become an eventual mass market item?

PUTMAN: Personally, I'm not really qualified to answer that, but I put Closed Circuit TV in your home on a class with gadgets. You break it out for parties and other than that you don't use it very much. I don't have any doubt but what it will catch on, but more as a fad than legitimate use. What I really think you're going to see in the home is the video-tape service taken over by the telephone company. You will pay for the service like you will pay for a phone call and there will really be no need to go out and buy a unit.

BOB: Perhaps you could give an example of a new product development?

PUTMAN: Let's take an older product. We found out that there were

tremendous variety of environmental conditions that cameras were constantly being confronted with. A few years ago when transistors were just coming out and we decided the transistor would solve some of these problems. In this particular instance, the need was not uncovered by any particular group it was really recognized by everybody. The solution to filling that need was spotlighted by engineering.

With us we had to weigh very carefully the risk of going into transistors where if we had been a military department, this risk would be almost non-existent. We went out into the market with a completely new and different product. Nobody could touch it. Fortunately, we got there with transistorized cameras about a year and a half before our competitors could catch up and this was enough time for us to gain a significant lead in terms of profits.

BOB: Was this effort financed by the product department itself or were other financial arrangements made?

PUTMAN: Practically, no - technically, yes. Obviously, we're within a very large complex company. When a product such as this has as large a ramification as the one we got into, you can get financial help.

BOB: How much long range planning actually is done getting ready to make a major technological breakthrough?

PUTMAN: This is a sore subject. I don't think we're doing enough of this. I wish we were doing more. This, of course, is a matter of judgment as to how much you should be doing. I try to personally write down a five and ten year forecast outlining where things are going technologically.

BOB: Do you feel that the profit center concept and the pay-as-you-go concept impedes your ability to innovate?

PUTMAN: This is a subject which has come under lots of discussion recently. This is one of the problems with decentralization.

BOB: Do you feel that, (1) the control placed on the industry by the FCC and, (2) by the fact that you already have many thousands of television receiver units out that were developed under existing technology - put severe perameters on your ability to innovate?

PUTMAN: Certainly, they limit innovation. In any business there are certain perameters. These happen to be the perameters of our business. If you're going to serve the broadcasters of the U.S. then you work by these perameters. If you're in another business, you have different perameters. Therefore, it's difficult to say if these perameters are slowing us down, because without these perameters we might not have anything at all.

Let's pretend you're going to serve, say, Houston and the space center and you're working on a simulator where one of the requirements is a transmission of a picture at a hundred mega-cycles. By the same token if you go to outer space, you have other perameters you have to work with such as the function of weight versus power. In just about any market, because of the perameters, anything you do is going to be a compromise.

BOB: Do you feel that foreign technology is a significant input to technological information?

PUTMAN: Yes. Currently, for example, I have a report just this morning that's coming in from England which is the product of a long telephone conversation we had just two weeks ago.

BOB: Does licensing represent a source of information within this product group?

PUTMAN: Yes, definitely. You have two kinds of licenses. One where you want to build the product and the other as a technical exchange. Sometimes you get the horrible feeling that it's a one-way street. The foreign engineers come over here and seem to sap all the information out of us. We can, if we're lucky, get some return on it. We go back and try to find out something from them. Occasionally, it is quite beneficial.

The following data relates to the percentage of time Mr. Putman and his men spend in search and dissemination of technological information over a year. Also included are estimates of the number of trips made during the year in order to attend trade shows, trade and professional conferences.

Percent of time in search and dissemination of technological information?

2 5 8 10 12 15 18 20 22 (25) 25+

Average number of trips taken by managerial personnel in your section over a one year period in pursuit of tech information?

- four to five conferences a year

- each man should have the opportunity to attend one.

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5. Additional comments by Mr. Putman follow:

BOB: Do you feel that the government should embark upon a large dissemination program for technological information where you would need special categories of information specifically designed for the electronics industry, the chemical industry, steel industry, etc., because of the requirements of semantics?

PUTMAN: Yes, I do definitely. It's a day of specialization and I think as finely as we can define concepts, the better off we're going to be.

BOB: Do you feel that time is critical with a dissemination system?

PUTMAN: No, I doubt that time is the factor, it's avilability, ease of access and completeness of information which are the most important things. I think one of the biggest things that needs to be done is letting people know that dissemination services are available. For example, you mentioned previously that NASA had computerized dissemination services and that's literally the first time I've ever heard of them.

BOB: Do you feel on a whole that it is, in fact, the responsibility of these agencies such as NASA and the Defense Department to disseminate the technical information they utilize through their research programs?

PUTMAN: Definitely. I feel there definitely can be a fall-out of technical information. I would say what happens many times in government contracts is that the information derived from government research is applicable to future commercial products and not to current commercial products. Therefore, you are limited to your use of military information by your budget constraint on future development. For example, most of the work NASA per se is doing now is so heavily environmental that it is not applicable to what we are working on commercially here at GE. But in the future NASA information could be very applicable.

In the way of a current example we might talk about cybernetics. Automation is the direction commercial camera is headed. It's been used for a long time in the military and, therefore, the military's the logical place to go to find out what has been done. NASA information on all forms of automated control could be quite useful.

BOB: Are there problems with government reports?

PUTMAN: If I know the document number, no matter how I find it out, I have no problem getting it from the library. One of the biggest problems is finding that there is a source. This because of the classification of government data. I feel it is not adequate. As a commercial department, no matter how we look at ourselves, we are required to fund ourselves. Most government information which could do us some good, appears to be classified. If it's classified we cannot use it because we are a commercial product department.

VISUAL COMMUNICATIONS

Interview Summaries

Name: Mr. J. Tillman

Title: Manager of Audio-Visual Design Engineering

Job Description: Mr. Tillman divides his forty people into two product teams: those associated with design and standardization and another team which modifies existing systems and in fact tries to develop new designs. But, a point to be remembered is, Mr. Tillman has approximately one-third of all the technical people under him. Therefore, as line operational manager, he has a tremendous amount of influence, and a tremendous amount of responsibility. Both of his design groups, even though one is working on futures, are working immensely concerned within a short-range time period, which Tillman defines as around a two-year period.

Additional comments by Mr. Tillman himself follow:

TILLMAN: My job title at the moment is Manager of Audio-Visual Design Engineering, which relates to the designing of audio-visual equipment. The job has nothing to do with transmitters or antennas, just audio-visual design which includes cameras (black and white), color cameras, film, both color and black and white, plus video tape replay on black and white, but no color. Companion audio equipment to work with video equipment is designed by our group along with video-switching equipment which is similar to a telephone exchange where signals come and you route them to whatever destination you prefer.

I have a second group that does special requisition work. Requisition work takes on two forms, one of which would be modification of standard existing equipment to meet special requirements of customers. The other would be the design of brand new equipment.

Major focus of the interview:

1. The types of media most frequently used to acquire technological information from sources outside the company.

2. The motivational stimuli for those who receive or search for technological data to pass it on to a colleague or store it for future use.

3. The manner in which the technological information gets absorbed into the commercialization or new development process.

4. Lastly, a rough estimate of the percent of time spent in search and dissemination, including the number of trips made to trade shows and professional conferences.

5. Other relevant comments made in the course of the interview.

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1. The respondents attempted a media ranking from the following:

TIS (Technical Information Series)
journals: trade
journals: professional
R & D lab reports
electronic lab reports
trade shows
customer contact
in-house conferences (GOSAM, TAM-TAC)
personal contacts in and out of house
patent and licensing information
consultants
other product departments
government technical literature
GE library
Department library
supplier catalogs
vendor information
dealer information
foreign liason offices
corporate analyses

Mr. Tillman felt that the following media were used most frequently (in descending order):

- R & D reports
- TIS
- trade and professional journals
- customer contact
- GE library
- government reports

Mr. Tillman also remarked that he had never heard of the DOD link-up with the GE Library System or the TAM-TAC sessions between product departments.

Additional comments by Mr. Tillman follow:

BOB: What is your biggest communication problem?

TILLMAN: I'd say that the biggest problem is getting precise information from our customers. There are too many levels of men between the final user and engineering. We try to counter the effect of information distortion by getting out and talking to the customers directly, but that's not really our job. The marketing people have the responsibility for transmitting consumer information to us, especially if it could have an impact on technology or design.

BOB: Do you feel professional conferences are fairly beneficial in keeping up or staying ahead?

TILLMAN: The primary benefit to me so far has been to see how far behind the others are. Only two or three companies lead in our area.... I think that we're at least even or ahead of most.

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2. The respondent's comments about motivation for search and dissemination activity were based on one of the following reasons:

    1. Professional pride and sincere desire to fulfill job responsibilities.

    2. Because each man knows that part of his year-end evaluation made by his boss examines how well he has pursued problems and taken advantage of GE facilities in attempting to solve them.

    3. Monetary incentives (direct), such as awards for inventions or patents.

    4. To impress someone.

Mr. Tillman answered in the following way: 1.

The greatest inhibitor to better motivation was cited as one or more of the following reasons:

    1. Job pressure and time constraints.

    2. Superiors not motivated.

    3. Motivation as high as can be expected.

    4. Dissemination inhibited in order to maintain job security and expertise.

    5. Inherent professional unwillingness to accept wholeheartedly someone else's research.

Mr. Tillman answered in the following way: 3.

Additional comments by Mr. Tillman regarding motivation follow:

People tend to specialize in our business. And, there's professional pride, you might say, on being on top. We find, particularly, if a fellow can get done what he thinks should be done, and is successful, then he tries harder next time.

BOB: What is the general attitude of your unit? Is it an industry leader?

TILLMAN: Well, there are two answers. One's as far as attitude, it's a gung-ho group. Fortunately, they drag me along with them. As far as leadership in the industry, it's my private and outspoken view, that this is probably the best design group in this business.

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3. The following comments by Mr. Tillman concern the commercialization process. Three basic questions were asked, but not always answered:

1. What are the decision-making steps in the commercialization process?

2. From which end of the spectrum do most of the new development ideas come, i.e., stimulated by marketing covering a consumer need or by engineering developing a new technology or product?

3. At what point does marketing enter the commercialization process?

The following comments are by Mr. Tillman:

BOB: Is there, in fact, some new product group that is continually analyzing product possibilities?

TILLMAN: We have what is called a product planning group, which really is within the marketing group, consisting of two people. I think they are making strides, but they have some way to go.

We like to precede all design work with as much preplanning and preinvestigation as possible. We try to determine in advance what our customers will want. Generally, we will investigate the future state of the art, as opposed to the present state. In some cases, we will decide what the state will be, and go down that path. But as for fundamental basic research of any phenomena which would not have a direct application with a couple of years, we don't do that. We will, on rare occasion, hire another product department in G.E. to look down certain avenues for innovation.

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4. The following data relates to the percentage of time Mr. Tillman and his men spend in search and dissemination of technological information over a year. Also included are estimates of the number of trips made during the year in order to attend trade shows, trade and professional conferences:

Percent of time in search and dissemination of technological information?

2 5 8 10 (12) 15 18 20 22 25 25+

Average number of trips taken by managerial personnel in your section over a one year period in pursuit of tech. information?

- three to four conferences per year

- each man should have the opportunity to attend at least one.

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5. Additional comments by Mr. Tillman concerning communication, development, and government dissemination:

BOB: Is there any way in which you feel your information sources could be improved?

TILLMAN: The only place I know where our information could be improved would be in the acquisition of more customer contacts and more industry contacts, particularly user parts of the industry.

BOB: Now, who takes actual responsibility for customer contacts, the marketing people, or the design people?

TILLMAN: The marketing people. They could do a little better -- by making use of engineering people here -- having them meet the customers, etc.

BOB: How about the information flow going from design to marketing to customer?

TILLMAN: The way this is generally handled is by means of whatever type of paperwork we generate for a product. There are certain standards, specifications, and descriptions of equipment that are prepared before design. When the project is completed, these are checked against the result that we achieved. If they still agree, then this information in a pretty formal manner is given to marketing. Marketing then prepares all the basic sales literature around that information we send them.

BOB: Do you feel that the fact that you must finance and support your own research work in any way hinders the potential of the unit to develop?

TILLMAN: No. I feel it's the only way to go.

BOB: What's your biggest development problem?

TILLMAN: My biggest problem is to have the designs frozen at some period so that we can then standardize the documentation. You can't continuously innovate and try to incorporate your ideas into one product, because it never gets completed. It's a never-ending process.

BOB: And how long have you been with General Electric Company?

TILLMAN: Sixteen years.

BOB: Did you ever work at the Defense Department or NASA?